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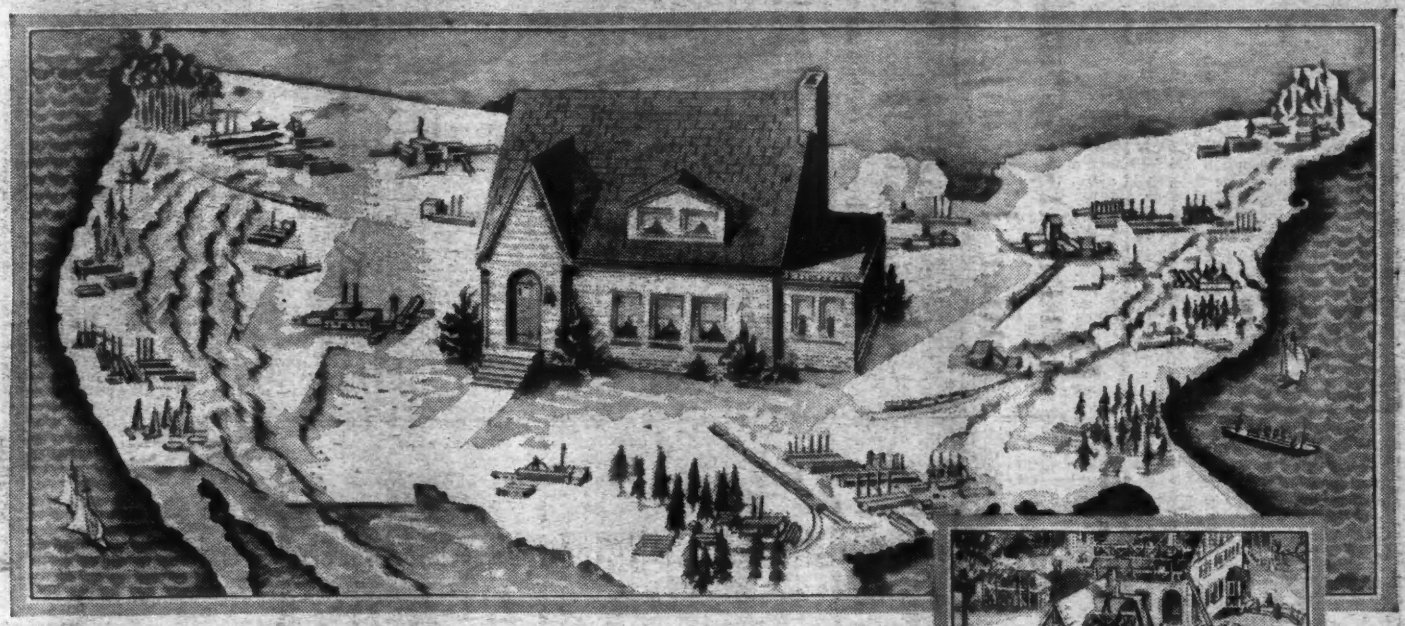

HOME BUILDING *and* THE NATION

Residence Construction This Year Will Benefit Many Industries as Well As Prospective Owners

By ROBERT P. LAMONT
Secretary of Commerce

CONSTRUCTION of new buildings and engineering projects, maintenance and improvement of existing structures, and expenditures for other capital goods have recently been emphasized as the field where voluntary effort will accomplish the most in sustaining active business and employment.

First, the vast area of public works expenditures has been surveyed by the governors of the States in accordance with a request from President Hoover, so far as the State and local governments are concerned, and by the Department of Commerce for the Federal Government. The results of this survey show a prospective outlay of at least $3,325,000,000 for the year 1930, a distinct increase over similar expenditures in 1929.

We have created a new division in the Department to encourage and foster what President Hoover has termed "energetic, yet prudent" advancement of public works. Organized business, nationally and locally, is cooperating splendidly, which gives still further assurance of a large volume.

Second, the programs of the great public utilities for additions and betterment to plants and equipment have been announced as follows: The railways, $1,050,000,000, an increase of $275,000,000 over 1929; the electric, gas, and electric railway companies, $1,400,000,000; and the leading telephone company, $700,000,000. With several lesser groups of similar nature, the total contemplated expenditures in this field will amount to more than $3,250,000,000, well above any previous program.

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A THIRD great group of capital expenditures is within the direct control of manufacturing, commercial and other types of industrial enterprises that are carried on throughout the length and breadth of the country.

The National Business Survey Conference and the Chamber of Commerce of the United States are together engaged in a well-considered systematic program for encouraging business men to go ahead with their betterment programs, and those who are not reached directly through trade associations are being reached through the efforts of local bodies. The bulletins being issued under Mr. Barnes' direction are admirably adapted for these purposes.

The great field of residential building and improvements to existing dwellings is in some ways the most difficult of all to cultivate, and I am glad to know that it occupies a leading place in the consideration of leaders of the construction industry. The owners of most of the homes that America's 29,000,000 or 30,000,000 families live in are not so easily reached, for example, as the presidents of the Class I railways.

Residential building contracts fell off sharply in 1929, below any of the preceding four years, and a great deal depends on the measures you may devise to recover as much as possible of that loss. If the construction industry handles the present situation soundly the tide will be in its favor sooner or later.

Millions of American families that have already absorbed motor cars and other modern inventions into their standards of living will want to incorporate better housing standards into their scale of living during the next few years. The advance is not confined to the upper income groups.

From various cities it has been reported that vacancies in the least desirable types of houses have increased during the past few years, and that houses at the lowest rentals have to be kept in better repair in order to retain tenants. I take it that what those connected with construction want to do now is to make the most of this latent demand in whatever way seems to you practicable.

You are going to encounter the problem of financing, the problem of determining just what are the home owner's wants, and the problem of how best to cooperate in meeting them.

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I HAVE dwelt mainly with the emergency phases of the situation that confronts us right now, but at the same time I believe that a firm foundation for future progress is being laid. Especially I am glad to see gatherings of the different groups connected with construction that have so many common problems and mutual interests, I hope that experience gained in working together now on problems of immediate national importance will hasten the day when all groups will regularly cooperate in dealing with such matters.

Broadly speaking, the job is to survey the market as it stands today, both supply and demand, and to see what can be done to widen the demand. The commodity that can be offered to the American people is dwellings, the homes in which they live. More than half of the homes are rented; owners may be convinced that it will pay to improve them.

If elements of the construction industry set out to sell the idea of the whole house to American families they will affect, not only the market for new houses and the demand for remodeling and modernizing existing houses in the hands of individual owners, but also the improvements that may be made by landlords.

The principle is becoming more and more recognized in the broader strategy of salesman-

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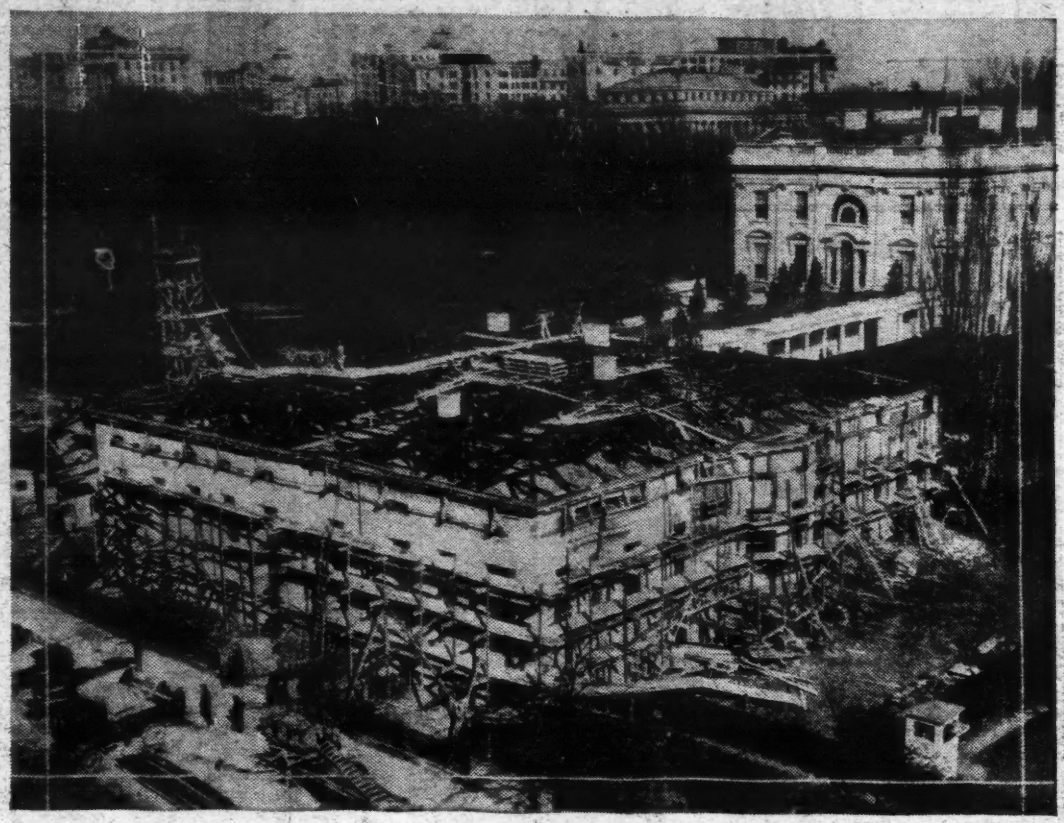
THE NEW WHITE HOUSE OFFICES

THE roof of the White House Executive Offices building, extensively damaged by fire Dec. 24, is being reconstructed in a manner that will give it both permanence and resistance to flames. This is in marked contrast to the type of construction originally used.

When the structure was first planned, in 1902, work proceeded on the theory that the building was only a temporary affair, calculated to provide facilities until permanent quarters might be afforded the executive offices.

Congress took a hand in the plans after they had been given their first draft, however, and decreed that the foundations and the exterior walls should be of a permanent type, while the interior walls and the roof were to be built in a less substantial manner. The intention was to permit future addition of a second story to the building if such action might be desired.



Horydczak

Will Give Long Service

AS IT is now being rebuilt, the structure will be in a position to give service close to the White House, even after increased business of the executive branch of the Government makes creation of office space in another location imperative. In addition, the reconstructed building will provide an architectural balance for the wing which extends from the opposite side of the White House.

The photograph reproduced on this page shows the stage which the reconstruction reached this week.

TESTING PAVEMENT SURFACES

By L. W. TELLER
Senior Engineer of Tests, Division of Tests
U. S. Bureau of Public Roads

THERE has long been a need for a test which would indicate the surface hardness of concrete pavements. While normally the wear produced by rubber-tired vehicles is not serious, there are cases where the surfaces of concrete pavements have not possessed the necessary resistance and appreciable wear has occurred. The engineer has had no way of measuring the effect on surface hardness of factors such as sand-cement ratio, type of sand, admixtures or methods of curing, and for this reason there is a noticeable lack of data on the subject of wear resistance. A number of methods of test have been proposed at different times but none of these has come into general use. This paper describes a device which has been developed by the Bureau of Public Roads for indicating, by tests in place, the surface hardness of concrete pavements. It was designed primarily to secure data on the relative surface hardness of concrete cured by different processes and has been in use sufficiently to demonstrate its usefulness.

Principle of Machine

THE principle of the machine is very simple. Three narrow steel wheels, placed tangentially to a single circular path are caused to roll along the path at a constant speed and under a constant load. The depth of wear produced in the circular path by any given number of wheel passages is used as a measure of the hardness of the surface being tested.

Mechanically the machine is not complex. It consists primarily of a wear unit and a power unit. The wear unit consists of a roughly circular steel plate carrying three 100-pound segmental lead weights and supported by the three tangential wheels mentioned above. This plate revolves around a vertical spindle at its center. The wheels are 8 inches in diameter, have a ¼-inch half-round face or edge and are made of hardened steel. The path followed by the wheels is 21 inches in diameter. The total weight of the unit is 453.5 pounds or 618 pounds per inch of width of the supporting wheels. The speed of rotation of the plate is about 36 revolutions per minute. Thus, any given point in the wear path is subjected to 105 wheel applications per minute.

The spindle in the center of the plate is connected through a knuckle to a vertical shaft set in a long verticle bearing in the center of the frame or power unit. This shaft is turned by a 1½-horsepower electric motor operating through a worm and worm gear. The shaft carries a spline which permits it to move up or down through the worm gear. As the wheels wear into the concrete the vertical shaft moves downward through the gear, since the shaft is connected firmly, although not rigidly, to the rotating plate and the gear housing is fixed in the supporting frame. This arrangement permits a determination of the depth of wear at any time by a measurement of the position of the end of the vertical shaft with respect to any fixed point, such as the gear housing.

When readings are being made, a steel U-frame is placed on two ground steel surfaces set in the top of the gear housing. This frame carries a micrometer dial reading to thousandths of an inch and the stem of the dial bears against the end of the vertical driving shaft. A revolution counter is actuated by a cam on the vertical shaft and may be seen back of the left leg of the U-frame. This counter registers the number of revolutions of the main plate.

Power may be supplied from any source, such, for instance, as a drill spindle, but the electric drive has been found to be very convenient and has the added advantage that the device may be taken anywhere in the field, provided that a small gasoline-driven generator is available.

It should be mentioned that wear wheels of soft steel were tried at first. Although not entirely unsatisfactory, they are not nearly so well suited to the purpose as the high-grade steel which has been hardened (and ground if necessary).

When the machine is being transported the frame is lifted off from the wear unit and is reassembled just before a test is made. This adds greatly to the portability of the machine.

Selection of Site

THE spot chosen for a test should be as smooth as possible, since data which are obtained from a rough surface are likely to be erratic during the early part of the test. The wear unit is placed in position over the spot to be tested and the frame is lowered over it. The knuckle, which couples the vertical shaft to the wear unit, is connected, and the three locking springs, which hold this knuckle in firm contact at all times, are fastened. The motor is connected to the power supply and the machine is set in motion. After the plate has revolved four or five times a set of initial readings is taken.

The procedure in taking readings is as follows: The position of No. 1 wheel is marked on the pavement and a reading is made with the micrometer dial. The plate is then revolved through 30 degrees and another dial reading taken, the position of No. 1 wheel being again marked on the pavement. The plate is revolved through another 30 degrees, a third dial reading is taken and the position again marked. These three dial readings are averaged for the initial or zero wear reading. The machine is now set in motion and the plate is revolved any desired number of times, say 25 or 50, after which another series of readings is taken, care being exercised that the position of the plate is the same each time as it was when the zero readings were made. It has been found that at least three readings are necessary to obtain a good average value for the depth of wear. Actually, this average is that of nine points on the wear tracks.

After reading the depth of wear the plate is again rotated the specified number of times and another series of readings is made. Experience will show the total number of revolutions which will constitute a satisfactory test. In the tests so far conducted between 1,000 and 1,500 revolutions per test have been used and it is believed that this number is ample. The results are purely comparative, however, no attempt having been made to standardize the test.

It was thought that the consistency of the data might be affected by the accumulation of dust in the path of wear. This possibility was investigated by running a number of duplicate tests, in one-half of which the dust was blown from the track at frequent intervals with an air blast. The data obtained indicated that neither the amount of wear nor the consistency of the results was affected to any measureable degree by the presence of the dry powder.

It has been noticed, however, that tests made when the pavement is moist show abnormally low wear, probably due to the fact that the worn particles, when damp, pack in the wear path and thus protect the bottom of the groove.

PLUMBING IN SKYSCRAPERS

PLUMBING experiments conducted some years ago at the Bureau of Standards, in cooperation with the subcommittee on plumbing of the Department of Commerce building code committee, have been resumed as the result of a recent conference at New York City, held by the committee. It will be recalled that the results of the previous series of experiments formed the basis for the so-called Hoover code, which has had a wide influence in determining plumbing requirements throughout the country.

The scope of the previous investigation was limited, both because of available funds and because of a demand for early recommendations covering plumbing in small buildings. It is intended in the present investigation to pick up the program and extend its field into plumbing installations in high buildings.

Recommendations for plumbing in such structures already have been brought out by the plumbing committee in response to continued requests, but the committee has recognized frankly that further experimentation will be necessary before the last word can be said upon the subject.

The actual experimental work will be done as before by experts of the Bureau of Standards, and the results will be interpreted by the committee so that they may be put to general use. It is estimated that the program will cover at least three years. Tentative plans covering such a period have been drawn up and preliminary investigational work is already under way.

Briefly, it is proposed to investigate actual conditions in plumbing stacks, drains and venting systems in large buildings, with the object of determining the actual facts that exist there.

Official announcement of the contemplated work has been made in Commercial Standards Monthly.

BUILDING IN COLONIAL TIMES

An Outline of Craftsmen's Wages

By ESTELLE M. STEWART, Department of Labor

BUILDING, in the earliest days of colonial settlement, was not important, and skilled building mechanics were few, especially in the southern colonies. There were two bricklayers, four carpenters, and one mason among the first settlers at Jamestown in 1607, but later, in 1609 and 1610, the Virginia Company of London advertised for building tradesmen to emigrate to the colony, apparently without results.[1]

Bricks were made in Virginia at the very beginning of the colony, but, according to Bruce, they seem "to have entered only to a limited extent into the construction of the dwellings,"[2] being confined almost wholly to chimneys. The rough structures of plank or log which housed the first Virginia settlers were probably erected without the aid of skilled builders. At any rate, no mention is made of definite wages paid building tradesmen prior to 1624, when the price of bricklaying was fixed at 40 pounds of tobacco ($2.43) per thousand bricks.

Scarcity of Artisans

SCARCITY of artisans of all trades persisted throughout the early history of Virginia. The company repeatedly issued broadsides advertising for mechanics and offered special inducements, such as grants of town properties for home building; and planters frequently wrote home to their agents directing that carpenters, bricklayers, and masons be dispatched to the colony under terms considerably more advantageous to the worker than those customarily offered for plantation labor. Later, after the Colonial Assembly was established, a law was enacted (1661-62) which exempted "handicraftsmen" from taxation. Although short-lived, this legislation suggests the lengths to which the colony found it necessary to go in its effort to secure an adequate supply of skilled craftsmen.

"The most favorable legislation, however," Bruce says, "was unable to create a large and prosperous class of mechanics in Virginia,"[3] or at least to insure their remaining in the trades to which they had been trained. The tendency was always to abandon the trades and follow the general drift of labor to the plantations. In 1633 an effort was made to force mechanics to follow their trades by enacting a law forbidding them to perform agricultural labor of any kind.[4]

Neither legislative policy influenced conditions materially. The indenture system, which seems to have been almost exclusively followed in the southern colonies, was not a satisfactory method of maintaining a supply of mechanics. If a craftsman had completed his apprenticeship before emigrating, his term of indenture was generally brief—four years at the most—and upon its expiration his place had to be filled by another craftsman, often with the attendant expense increased by special inducements to tradesmen. Frequently indentured mechanics became planters themselves when their terms were out. All these many difficulties in the way of keeping a sufficient number of mechanics in the colony resulted in the adoption by the planters of a practice of training their Negro slaves, whose terms of service did not expire, in the crafts necessary for the self-contained community which a tobacco plantation became.

While not leaving so specific a record to show it, the northern colonies undoubtedly suffered with the southern in the matter of scarcity of building tradesmen. On the other hand, there are quite early stories which suggest how the building problem was handled. The southern colonies settled on widely scattered plantations and had slight need for towns—in fact, opposed them. In the North, particularly in New England, the town was the important factor in colonial development.

The records of the town of Dedham, Mass., show that in 1637, within a few years of its founding, "a committee was "choesen to contrive the Fabricke of a meetinghouse to be in length 30 foote & 20 foote in breadth & between the upper & nether sill in ye studds 12 foote, the same to be girte, and to order men to worke upon the same in all workes as they are severally apted accordingly. As also to proportion the same worke and wages in all cases."[5]

Terms of Agreement

WHAT the wages were, on the basis of a daily rate, the record does not show. It says only that the following terms were adopted:

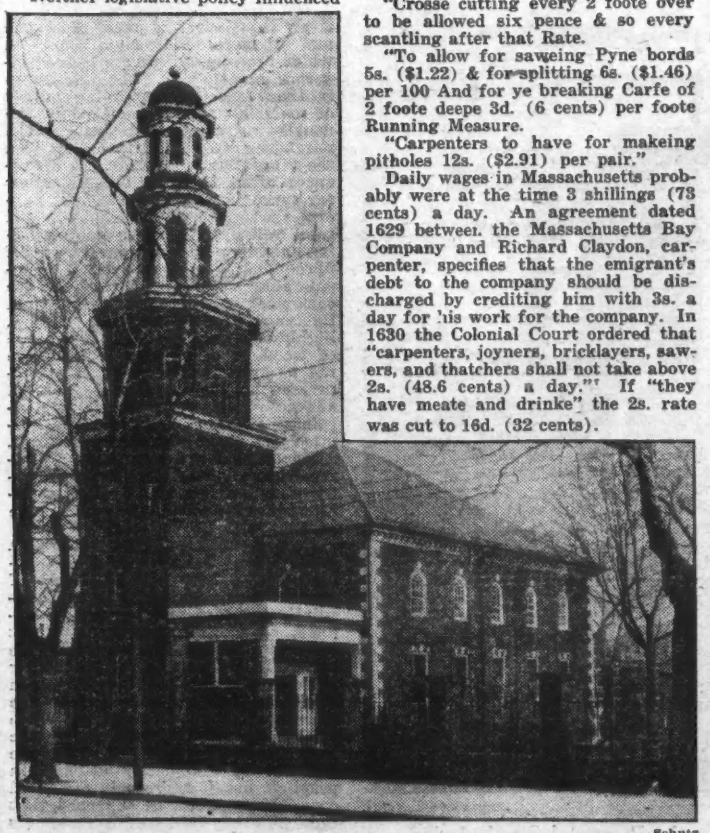
"There shall be allowed such as do fell Pynes of 2 foote over at ye carfe[6] six pence (12 cents) and for Oake of the same thickness eight pence (16 cents): and for grater and smaler after ye same Rate. If any tree split by the default of ye feller he shal loose ye felling.

"Crosse cutting every 2 foote over to be allowed six pence & so every scantling after that Rate.

"To allow for saweing Pyne bords 5s. ($1.22) & for splitting 6s. ($1.46) per 100 And for ye breaking Carfe of 2 foote deepe 3d. (6 cents) per foote Running Measure.

"Carpenters to have for makeing pitholes 12s. ($2.91) per pair."

Daily wages in Massachusetts probably were at the time 3 shillings (73 cents) a day. An agreement dated 1629 between the Massachusetts Bay Company and Richard Claydon, carpenter, specifies that the emigrant's debt to the company should be discharged by crediting him with 3s. a day for his work for the company. In 1630 the Colonial Court ordered that "carpenters, joyners, bricklayers, sawers, and thatchers shall not take above 2s. (48.6 cents) a day."[7] If "they have meate and drinke" the 2s. rate was cut to 16d. (32 cents).



Schutz

Christ Church, located in Alexandria, Va., is a fine example of seventeenth century construction in this country. This church was George Washington's place of worship.

Frederick A. Schutz.

Ruins of the Ravensworth House, a famed old structure in Virginia, which withstood the elements throughout a century before it was razed by fire.

Nevertheless, the rate apparently remained around 3s. a day, for three years later Governor Winthrop says that because carpenters and masons were receiving 3s. a day, on account of the scarcity of workmen, "it grew a general complaint which the Court, taking knowledge of, as also of some further evils which were springing out of the excessive rates of wages, they made an order that carpenters, masons, etc., should take but 2s. a day."

The pay of bricklayers in New York in the year in which Dedham built its meeting house, 1637, was 80 cents a day.

Occasional items of record in the ensuing 10 years indicate, in most instances, somewhat lower rates. Mechanics engaged in the construction of Fort Charles and Fort James, on the Virginia coast, in 1643, were paid the equivalent of 1s. 2d. (19.5 cents) a day in tobacco, the rate being 7 pounds per day, a pound of which at this time "did not exceed two pence"[8] in value. Bricklayers in Plymouth Colony were still working at the legal rate of 2s. a day, which the Plymouth Colony Court had undertaken to maintain even after the Massachusetts Bay Colony had abandoned the effort to control wages by legislation. The New Amsterdam rate remained about the same, that is, 2 florins, or 80 cents a day, for skilled men, and 40 to 50 cents for day laborers.[9]

Dedham, Mass., built a schoolhouse in 1648, "the lengthe 18 foot being 14 foot beside the chimney, the wideness 15 foot, the studd 9 foote betwixt the joynts, one floor of joyce: 2 convenient windows in the lower roome and one in the chamber, the plancher layed, the stayers made, the sides boarded feather-edged and rabbited, the doors made, and hanged." The total cost of construction was £17 6s. 10d. ($57.80), of which the builder received £11 3d. ($36.70) "for his worke about ye schoole house." laborers working under him were paid 1s. 8d. (28 cents) a day."

The School Building

NEARLY 50 years later Dedham needed a new schoolhouse to replace this early one. The selectmen met on Mar. 8, 1694, "to go threw with the agreement with John Baker conserning the schoole house," and they agreed—

"that the said John Baker shall goe on and build the schoole house, finding all timber, boards claubords shingles nailis glasse bricke stone & clay & borde the outside and claubord the inside & make it close warm and desent suitable to such a schoole house & to make one door and two windows containing twelve foots of glass also a good stone chimney nine foots between gams and to carry it out of the house with good bricke and to find whatever else is necessary & to finish said house to the turning of the Key by the First of June 1695. Excepting the upar floor & claubording the inside which flor and clauborading is also to be finished by the twenty-fifth day of October next after the date hereof. For and in consideration of this abovewritten we the Selectmen of Dedham doe agree in behalf of the towne that the abovesaid John Baker shall receive of the Town of Dedham twenty shillings ($3.33) in money att the time when said Schoole house is raised and fifteen pounds ten shillings ($51.67) at the twenty-fifth day of February next to be payed in corn in Rye at four shillings (66.7 cents) per bushel & Indian corn at three shillings (50 cents) per bushel & so much as shall be payed of the fifteen pounds ten shillings in money the said John Baker shall abate one-fourth part thereof. He is also to receive the old schoole house with what belongs thereto & the stone and clay of the town's lying by it."[10]

Towns in Virginia

WHILE towns multiplied in number and grew in size throughout the northern colonies, Virginia remained townless. Repeated efforts on the part of the British government to promote or compel the erection of towns failed, because the land-holding system upon which the colony was founded made community living economically impossible. After the restoration a very determined attempt was made by the home government to establish towns, and when Berkeley returned to the governorship in 1662 he carried with him instructions to erect a town on each river. Bruce remarks that—

"It is a significant commentary on the effect of the numerous laws which had been passed with a view to enlarging Jamestown that Berkeley was specially directed to begin at this place a new attempt at town-building in Virginia. Such was the recommendation which was necessary after all the carefully considered undertakings of fifty years."[11]

The General Assembly embodied the order of the British government in the "cohabitation act" of 1662, which, as analyzed by Bruce—

"constitutes one of the most interesting acts of legislation in colonial history, and might be regarded as a remarkable triumph of legislative hope over practical experience were it not for the statement of the preamble that the assembly had undertaken to encourage the building of towns because they looked upon it as their duty to conform to the wishes of their sovereign in England.

"Under the terms of this statute, it was provided that Jamestown should consist of thirty-two houses, a number which indicated that the General Assembly was disposed to be moderate and prudent in its requirements. Each house was to be forty feet from end to end, twenty feet in width in the interior, and eighteen feet in height. Each was to be constructed of brick. The walls were to be two bricks in thickness as far as the water table, and one and a half the remaining distance. The roof was to be covered with slate or tile, and was to be fifteen feet in pitch.

"Although the colony had prospered

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[1] Bruce, Philip A.: Economic History of Virginia in the Seventeenth Century. Vol. II, p. 400. [2] Idem, Vol. II, p. 134. [3] Idem, Vol. II, p. 413. [4] Hening's Statutes of Virginia, Vol. I, p. 208.

[5] Dedham Town Records, published by the Massachusetts Historical Society. [6] The point of cutting. [7] Massachusetts Bay Colony Records, Vol. I, pp. 74-75. [8] Governor Winthrop's Journal.

[9] Bruce, Vol. II, p. 416. [10] Bishop, J. Leander: History of American Manufactures, 1608-1860. [11] Dedham Town Records. [12] Idem. [13] Bruce, Vol. II, p. 538.

(Continued on Page 8.)

WRESTLING WITH THE WEATHER

Planners of Buildings Have Aid of Federal Insulation Study

NUMEROUS inquiries and requests have been received by the Bureau of Standards of the Department of Commerce for information on the subjects of thermal insulation and insulating materials, primarily with reference to buildings. Seeking to supply the information desired, the Bureau has undertaken a nontechnical discussion of the principles of heat transfer as applied to thermal insulation at ordinary temperature. The insulating properties of a number of general classes of insulating and building materials have been determined and estimates of the probable fuel savings resulting from the use of such materials have been made.

In developing information concerning thermal insulation which is to be generally applied, the Bureau has not attempted to prepare a comprehensive manual of insulation methods nor to discuss in detail the principles involved.

Before giving the general conclusions derived from work on insulating materials, the Bureau's experts deemed it advisable to present certain principles and to define certain heat terms which are not always clearly understood. These principles and definitions, as well as the conclusions drawn from the work, follow, being presented in the full text as issued by the Bureau.

Thermal insulation is concerned with the problem of reducing the transfer of heat from one region to another. The physical principles involved in the subject of insulation are thus identical with those involved in the subject of heat transfer. Heat is transferred by three general methods or modes, called, respectively, conduction, convection and radiation, which may operate either separately or in combination, depending upon the particular conditions. In any case the flow of heat invariably takes place from regions of higher temperature to regions of lower temperature.

The Conduction Process

IN SOLID materials heat is transferred by a process known as conduction, the exact nature of which is not completely understood. The amount of heat conducted from one region to another is proportional to the temperature difference between the two regions in question. The ability to conduct heat varies widely among different materials, metals being, in general, far better heat conductors than nonmetallic substances. It, therefore, follows that nonmetallic materials are, in general, better insulators than metals. Gases, with two exceptions, are the poorest conductors of heat, but, as will be discussed later, heat transfer through gases is usually complicated by other factors besides conduction.

The numerical measure of the ability of a substance to conduct heat is called its thermal conductivity, defined in customary units as the amount of heat in B. t. u. (British thermal units) which will flow in one hour through a uniform layer of material 1 square foot in area and 1 inch in thickness, when the temperature difference between the surfaces of the layer is maintained at 1° F. A B. t. u. is the amount of heat necessary to raise the temperature of 1 pound of water 1° F. The insulating value or thermal resistivity of a material is equal to the reciprocal (one divided by) of its conductivity.

Thermal conductivity is a property of the material itself, not depending upon the size and shape of a particular piece of the material in question, providing the latter is of uniform structure. It is, therefore, incorrect to speak of the conductivity of the material or materials of which the structure is composed.

When dealing with a given body, such as a building wall, its insulating value as a whole is measured inversely by a property known as conductance, defined as the amount of heat flowing through the wall per unit time and per unit area when the temperature difference between the surfaces and the wall is 1°. The insulating value or thermal resistance is equal to the reciprocal of the conductance. The conductance of a wall depends upon the conductivity, size and arrangement of the materials of which the wall is composed. If it consists of a single uniform material, its conductance is numerically equal to the conductivity of the material divided by the thickness of the wall.

If the wall is composed of parallel layers of different materials its conductance can be calculated easily from the respective thicknesses of the layers and the conductivities of the materials composing them. The insulating value of the wall is equal to the sum of the respective insulating values of the different layers. If, on the other hand, the wall does not consist simply of parallel layers, the calculation of the insulating value from the conductivity and dimensions of the wall component is much more difficult, and will not be discussed here.

Transfer by Convection

THE transfer of heat in a liquid or gas is usually complicated by other factors besides conduction. Conduction is always present, but the heat transfer is ordinarily greatly increased by fluid motion called convection, set up either automatically by reason of temperature differences or by means of mechanical stirring or blowing. The former is called natural or free convection and the latter forced convection.

The exchange of heat between the air in a room and the inside surface of the external wall is one of the simplest examples of natural convection. The heat loss from the outside wall surface to the outside air on a windy day is a familiar example of forced convection. The phenomenon of convection is rather complicated and can not be accurately expressed in terms of simple laws like those of conduction; but, as an approximation, heat transfer by convection can be regarded as proportional to the temperature difference.

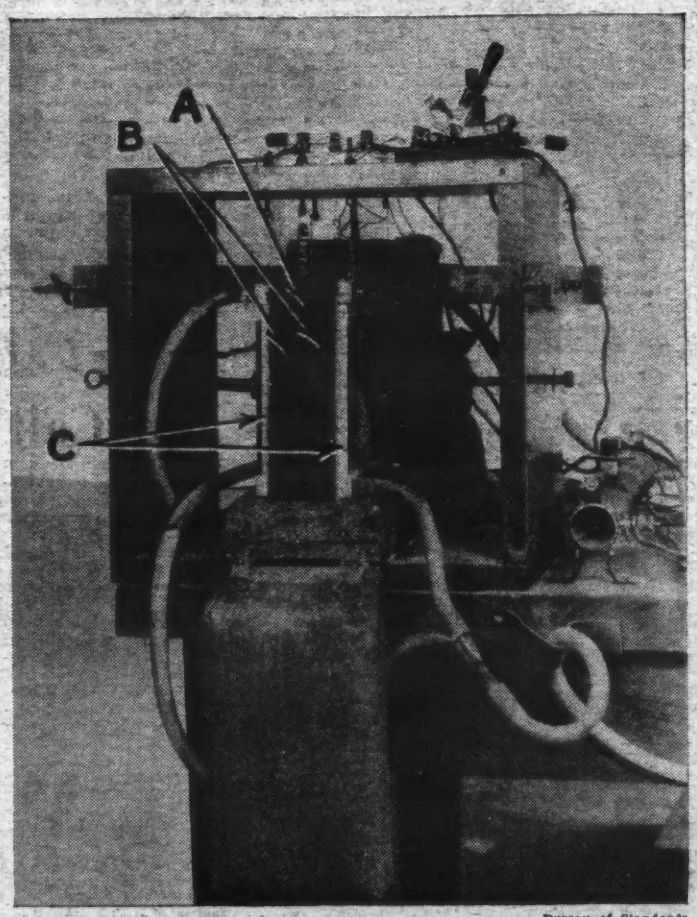
The transfer of heat from one solid body to another through the intervening air or other fluid medium is still further complicated by radiation, which results in a heat transfer practically independent of the presence of the air. The process is the same as the transfer of heat from the sun to the earth through the intervening space devoid of matter. Everybody is familiar with the radiation of heat from an open fire, but it is not so generally recognized that radiation plays a very imporant role in heat transfer at ordinary temperatures. In fact, about one-half of the heat transfer from a heated room to the inside surface of the exterior walls takes place by direct radiation from interior objects and partition walls. The other half is the result of convection in the air near the exterior walls.

Although air is a very poor conductor of heat, the insulating value of an ordinary air space is rather small, on account of the large transfer of heat by convection and radiation. Radiation is largely responsible for the ineffectiveness of air spaces bounded by ordinary building materials, such as are found in frame or other hollow walls.

The low insulating value is often erroneously attributed to convection; but, as a matter of fact, from 50 to 80 per cent of the heat transfer across air spaces of ordinary sizes takes place by radiation. If the air spaces were bounded by bright metallic surfaces, the transfer of heat by radiation would be greatly diminished, since clean metallic surfaces are much poorer radiators than nonmetallic surfaces, such as brick, stone, glass, wood, plaster, paper, etc.

Hold Plural Applications

THE terms conductance and resistance (insulating value), as already defined, can be applied to an air space as well as to a slab of solid material. On account of the large effects of radiation and convection, however, the insulating value of an air space is not proportional to its width (thickness), as would be the case with a slab of uniform solid material. Furthermore, the insulating value varies considerably with both mean temperature and temperature difference. For spaces more than about three-fourths inch wide the insulating value is practically constant, independent of the width. Narrower spaces have less insulating value, and below about one-half inch the insulating value is approximately proportional to the width.



Bureau of Standards.

This is the apparatus used by the Bureau of Standards in testing building materials for heat insulation value. The source of the heat is at A. The samples under test are seen at B B. Water-cooled plates are indicated at C C.

Under average conditions the conductance of the vertical air spaces commonly found in building walls is about 1 B. t. u. per hour, per square foot, and per temperature difference of 1° F. It will be seen later that this figure corresponds to an insulating value approximately equivalent to a one-third inch thickness of average insulating material.

A thermal insulator is essentially a material having a large percentage of relatively small voids containing air. Little, if any, convection can take place within such a material, and the solid portions effectively screen off the radiation, so that the low conductivity of air is utilized to a much greater extent that in an air space. Since every known solid material has a greater thermal conductivity than air, it is evident that the conductivity of air fixes the lower limit of the conductivity of insulating materials containing air. By exhausting the air from an insulating material the conductivity can be materially reduced, and, although this principle is made use of in certain types of thermos bottles and jars, it is impracticable on a large scale.

Fine-grained Structure

THE application of the term thermal conductivity has thus far been restricted to uniform or homogeneous materials. Insulating materials are obviously not homogeneous in the microscopic sense, but in a practical sense they may be considered homogeneous, since their structure is fine-grained in comparison with the size of the specimens ordinarily dealt with. Bearing this in mind, we may use the terms thermal conductivity and insulating value in the same sense as they have been used in the case of homogeneous materials.

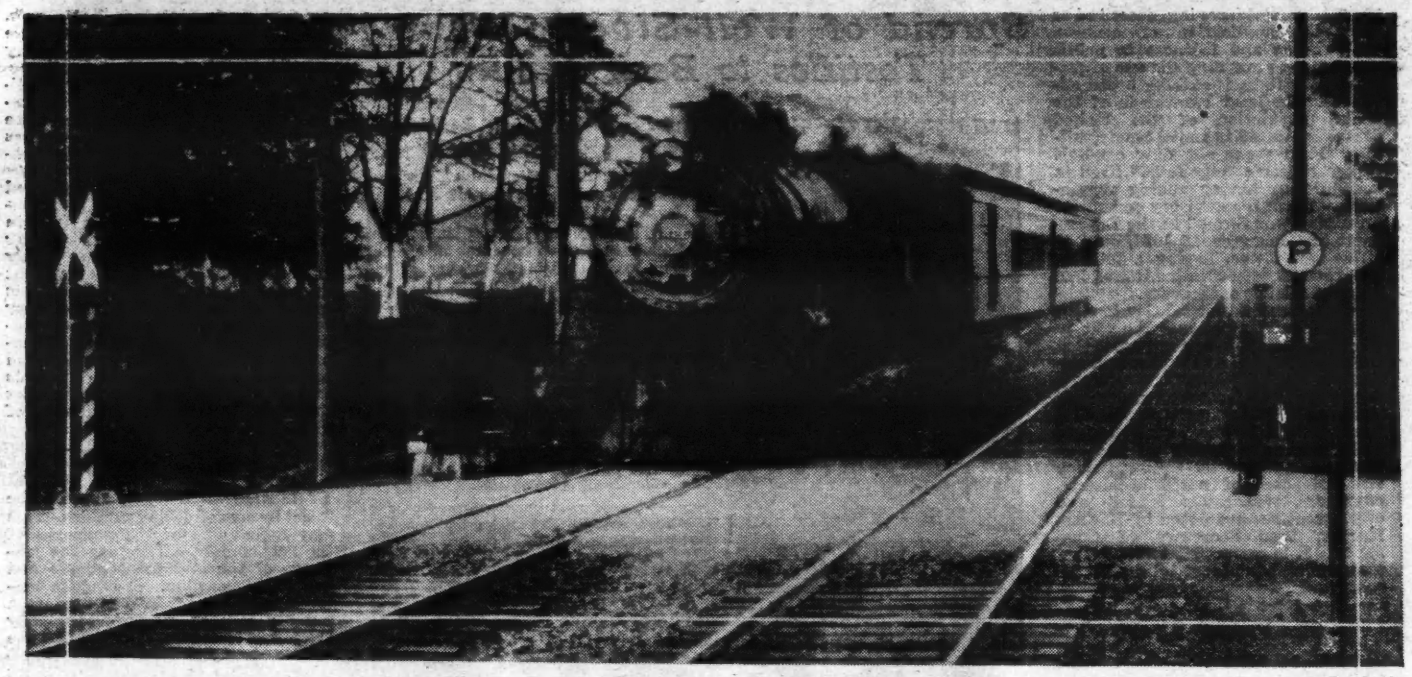
Investigation has shown that the differences in the respective thermal conductivities of the various light fibrous or cellular materials are not very great. The conductivities of most materials manufactured and sold primarily as insulators fall within the range of 0.25 to 0.35 B. t. u. per hour, square foot, and temperature gradient of 1° F. per inch thickness. Of such insulators less than 1½ inches of the poorest material is equivalent in insulating value to 1 inch of the best. The better insulators approach fairly closely to the ideal limit, since the thermal conductivity of air is only slightly less than 0.2 B. t. u.

Commercial insulating materials can be divided into two general groups —(1) fibrous materials either in loose form or fabricated into soft, flexible quilts confined between relatively thin layers of paper or textile and (2) more or less rigid boards in which the components are bonded together in some way. The differences in the respective insulating values of materials within each group are usually so small that the average purchaser can neglect them. In fact, the tabulation of these small differences often tends to obscure other far more important facts. In general, the lighter the material per unit total volume the better its insulating value per inch of thickness. Stiff fibrous insulating boards having considerable structural strength are somewhat poorer insulators than lighter and looser materials. Dense, highly compressed wall boards made of wood or other organic fiber are not as good insulators as less compressed boards of the same general character. Heavy wall boards containing plaster in one form or another are relatively poor insulators, although they are very useful building materials and, like building paper, may be valuable in reducing infiltration of air through an otherwise porous wall.

On page 10 is a chart showing in a general way the respective insulating values of a number of classes of poor heat-conducting materials. Insulating values, as previously defined, are plotted against the weight per unit volume of the material. The upper limit shown is the insulating value of a layer of still air 1 inch in thickness, and all other values are calculated on the basis of the same thickness. As discussed above, the high insulating value of air alone can not be completely utilized in practice, but it represents the ideal case. It must not be supposed that the insulating values of all materials fall exactly on one or another of the lines shown in the chart. These lines are only approximate, but they give

(Continued on Page 10.)

THE OGRE OF GRADE CROSSINGS



Borydczak

Coordinated Effort Is Needed for Solution of Problem

By FRANK McMANAMY
Interstate Commerce Commissioner

THE elimination and protection of grade crossings constitutes a problem of the present time.

While it is doubtless true that the Federal Government has a vital interest in this problem, in my opinion, it is one in which authority and responsibility ought to be coordinated and centralized in the States.

For a number of years the Federal Government has been expending in cooperation with the States about $75,000,000 annually in the development of the Federal aid highway system, and, of course, it is the desire of the Federal Government that this project not only contribute to the vehicular transport facilities of the country, but that in itself and by its example it further contribute to the promotion of safety in transportation. But the Federal aid highway system, as initially conceived, only comprises about 7 per cent of the highway mileage of the States, so that even if the most approved methods of safety be adopted in grade crossings on this system the major part of the problem still remains.

Basis of Interest

THE Interstate Commerce Commission is officially interested in the problem primarily from the standpoint of promoting the safety of rail transportation. Through our Bureau of Safety, cooperating with the railroads, we are constantly striving to reduce to a minimum the accident hazard on railroads, both in behalf of the traveling public and those whose duty it is to man the trains. Of lesser consequence, but nevertheless of great importance in any consideration of economical transportation, is the question of property damage growing out of railroad accidents, which is no insignificant factor in the economy of transportation.

The most recent figures available indicate that grade crossing accidents continue to increase, notwithstanding the earnest study and interest being given this problem by numerous public and civic organizations. During July, 1929, there were 438 grade crossing accidents in the United States, which caused the death of 185 persons and injury to 525 additional persons. During the corresponding month last year there were 374 accidents, involving the death of 148 persons and injuries to 434 others. During the seven-month period ended July, 1929, there were 3,109 grade crossing accidents, as compared with 2,995 accidents during the corresponding period of 1928, with proportionate increases in the number of casualties. And it should be noted that the months included in these figures do not cover a period of the year during which highway traffic is at its peak.

It does not appear necessary, therefore, to go beyond these figures to impress the importance of dealing with the problem on broad lines and with all possible completeness at the earliest time.

"The National Association of Railroad and Utilities Commissioners and the national conference on street and highway safety, not to enumerate a considerable list of other agencies, are giving study to the problem and doubtless will contribute toward its solution. It appears to me, however, that we must gain a high degree of cooperation from the railroads and an enlightened public interest which will support an equitable division of the costs of eliminating or protecting properly all important grade crossings.

In the past, efforts to eliminate grade crossings have frequently resolved themselves into contests between the railroads on the one hand and the public or public authorities regarding the division of expense involved in the undertakings. Frequently the railroads have been required to bear from 40 per cent to 70 per cent of the expense without much in the way of direct return.

"In recent years, however, changed traffic conditions have materially increased the obvious advantages to carriers which are likely to follow the elimination of grade crossings. Grade crossing accidents make for undesirable publicity wherein the railroad is likely to suffer blame, regardless of the circumstances or individual responsibility. Moreover, the motoring public has become a mighty factor in American public opinion and railroads do not enhance their standing with that public through the risks, delays and annoyances caused by the present grade crossing situation.

For Safer Highways

MOREOVER, the railroads are constantly developing a more direct interest in grade crossing safety from the standpoint of users of the highways. The most recent figures available (June, 1928), show that 64 steam railroads engaged in distance haulage were operating over 1,000 motor coaches over a mileage in excess of 14,800. Similarly classified carriers operating motor trucks in freight traffic numbered 45. The number of trucks so operated was about 5,000 and the mileage covered was in excess of 3,500.

More recent figures obtained from manufacturers' records of orders indicate a considerable expansion of the motor coach and motor truck business by steam railroads without, of course, taking into consideration the tremendous general increase in this business by private operators which are not directly associated with steam railroads.

Generally speaking, it seems to me that some considerable impetus can be given toward a solution of the problem at least to the point where grade crossing improvements are at least keeping apace with highway extension by giving heed to the following suggestions:

(1) That in States where adequate and comprehensive information regarding grade crossings is not now available, surveys should be made to the end that the extent and scope of the problem, and the points at which it is most acute, may be known.

(2) That a definite program of elimination and protection of grade crossings in each State should be formulated.

(3) That efforts be made to gain public recognition for the opinion of traffic experts that the only complete and satisfactory solution of the grade crossing problem at points where heavily traveled highways cross railroads over which frequent or high-speed train movements are made is the elimination of the grade crossing.

(4) That there should be uniformity in the indication of grade crossing protective devices throughout the country.

(5) That future traffic conditions be considered and appropriate provisions made for safety in opening all new grade crossings.

(6) That all public and private agencies interested in the problem cooperate in bringing the public to a realization of the need of a definite program for the elimination and protection of grade crossings, and, moreover, as an immediate and partial remedy that they further cooperate to secure the adoption of educational measures designed to bring about the exercise of greater caution and greater observance of signals at grade crossings.

NEW CAPITOL

PLANS for erection of the main unit of the new State capitol of West Virginia have advanced to the point where bids for construction of the edifice have been requested, according to an announcement by Governor William G. Conley. The bids will be opened Mar. 5 in the office of the governor.

The structure, of fireproof construction throughout, will face the Kanawha River. The central part of the building will be 536 feet long by 106 feet wide and three stories high. The dome will rise 266 feet above its surroundings. At each end will be a wing 94 feet by 60 feet, one story in height. These wings will form the connecting links between the main unit and the two-wing units recently completed and now occupied.

The bids will be received Mar. 5 and will apply to the contract for furnishing all labor and material for the general construction and also to the contract for the installation of the mechanical equipment plant.

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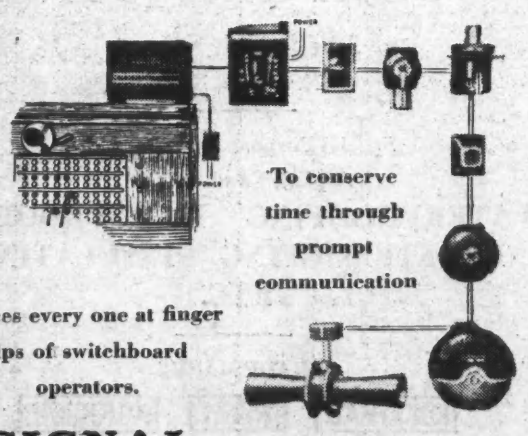

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GUIDANCE FOR GROWING CITIES

Spread of Well-Studied Zoning Testifies to Basic Values

MUNICIPAL zoning, described as the application of common sense and fairness to public regulations governing the use of private real estate, is making broad advances. At least two-thirds of the urban population of the United States is located in zoned municipalities. Four years ago only one-half of the Nation's "city folks" lived in communities having zoning regulations. When the advisory committee on zoning was formed in the Department of Commerce, in 1921, only 48 cities and towns, having a total of less than 11,000,000 inhabitants, had adopted zoning ordinances.

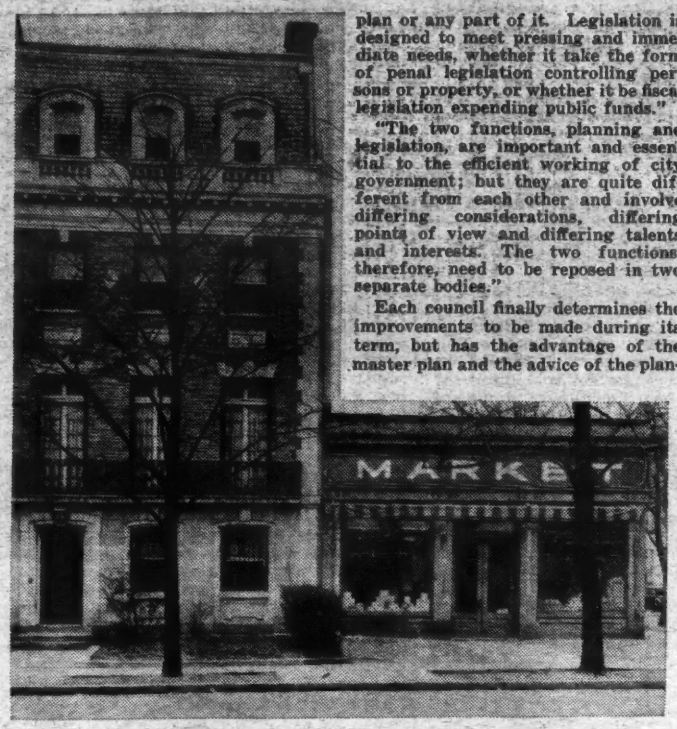
Soon after the Federal Government began to give intensive thought to the situation it became apparent that zoning would have to be brought under an orderly direction. Accordingly, work was begun on a standard State zoning enabling act, the first draft of which was issued in 1922 under the sponsorship of the advisory committee on zoning, which was composed of noted architects, engineers, real estate leaders and city executives appointed by Herbert Hoover, then Secretary of Commerce. It is under this standard act that zoning has proceeded during recent years.

The Present Status

AT LEAST 691 municipalities in the United States have now recognized the value of farsighted planning for their orderly physical development by establishing official planning commissions or boards, according to a new tabulation made by the division of building and housing of the Department of Commerce. Based on the 1920 Census figures, 208 of the 691 municipalities listed are cities of over 25,000 population, while the remaining 483 are communities of varying size down to villages of less than 1,000. Several of the smallest of these had under 500 inhabitants. Geographically, the interest in city planning is also widespread, Massachusetts showing the greatest number of commissions in any one State, with California next. Considering the population and total number of communities in the State, Wisconsin, Illinois, Kansas, Texas and Florida all show a decided activity in this field.

In addition to the 691 municipalities listed in this tabulation as having official commissions, there also have been included 41 which have been reported as having unofficial boards or committees interested in the same objectives, but functioning in an unofficial rather than an official capacity. These boards are for the most part committees of chambers of commerce, city council committees, advisory groups or representatives of civic organizations which have been delegated to investigate this subject.

The large number of municipalities of all sizes which at this time have planning commissions, and the fact that the interest in planning activity is not confined to any one region of the country, indicate a general appreciation of the need for modern city planning. Cities having planning commissions are believed to be more apt than others to exercise foresight and true economy in controlling the laying out and improvement of streets, the location of parks, playgrounds and public works, the development of transit and transportation, provision for street traffic, and in regulation of private use of land through zoning ordinances.



Handsome homes and small shops rarely become streetfellows where intelligent zoning regulations are in force.

Committee's Statement

THE advisory committee on city planning and zoning of the Department of Commerce, composed of eminent men appointed by the Secretary of Commerce, states in regard to the functions of planning commissions:

"Planning is intended to be a process whereby the larger lines and directions of future public and private development will be influenced and to some extent controlled. It should be designed to cover a long period of years, much longer than the term of office of any single city council, including the city council which is in office at the time of adoption of the plan or any part of it. Legislation is designed to meet pressing and immediate needs, whether it take the form of penal legislation controlling persons or property, or whether it be fiscal legislation expending public funds."

"The two functions, planning and legislation, are important and essential to the efficient working of city government; but they are quite different from each other and involve differing considerations, differing points of view and differing talents and interests. The two functions, therefore, need to be reposed in two separate bodies."

Each council finally determines the improvements to be made during its term, but has the advantage of the master plan and the advice of the planning commission to aid it in making decisions.

The data in the latest tabulation have been obtained from the records of the division of building and housing and from information furnished through the cooperation of city planning and zoning experts, municipal leagues, State, county and city officials, chairmen and members of local city planning and zoning boards and others.

THE standard State zoning enabling act was first issued in mimeographed form in August, 1922. A revised edition was made public in the same form in January, 1923, and the first printed edition was published in 1924. Two years later the text was revised in minor degree and the act then took the form which it has held since that time.

The general conditions under which the standard act has governed zoning activities are outlined in the following explanatory notes accompanying the text of the measure:

A general State enabling act is always advisable, and, while the power to zone may, in some States, be derived from constitutional as distinguished from statutory home rule, still it is seldom that the home rule powers will cover all the necessary provisions for successful zoning.

No amendment to the State constitution, as a rule, is necessary. Zoning is undertaken under the police power and is well within the powers granted to the legislature by the constitutions of the various States.

This standard act was prepared with a full knowledge of the decisions of the courts in every case in which zoning acts have been under review, and has been carefully checked with reference to subsequent decisions. A safe course to follow is to make only those changes necessary to have the act conform to local legislative customs and modes of expression. Especial caution is given to beware of adding additional words and phrases which, as a rule, restrict the meaning, from the legal point of view.

A Natural Effort

IT IS natural to try to shorten the act by consolidating sections. This may defeat one of the purposes of the act, namely, of keeping the language of the statute as simple and concise as possible. It is much better to have an act broken up into a number of sections, provided they are properly drawn, than to have one or two, or a few long, involved sections. While it is recognized that some of the sections in the standard act could be combined, it is put purposely in its present form.

No title of the act and no enacting clause are included. These are purposely omitted, as the custom varies in almost every State. The act should, af course, be preceded by the appropriate title and enacting clause in accordance with the local legislative custom.

No definitions are included. The terms used in the act are so commonly understood that definitions are unnecessary. Definitions are generally a source of danger. They give to words a restricted meaning. No difficulty will be found with the operation of the act because of the absence of such definitions.

Some States have included in the enabling act a declaration to the effect that the finding void or unconstitutional by the courts of one section or provision shall not affect the rest of the act. This is so well accepted a principle of legal interpretation that it seems unnecessary to include it in the act. If any State desires to have it included, it can be added without danger.

Some laws contain a provision to the effect that "the powers by this act conferred shall not be exercised so as to deprive the owner of any existing property of its use or maintenance for the purpose to which it is then lawfully devoted." While the almost universal practice is to make zoning ordinances nonretroactive, it is recognized that there may arise local conditions of a peculiar character that make it necessary and

(Continued on Page 8.)

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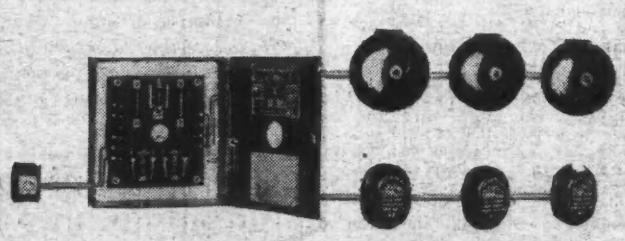

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PREVENTION OF FIRES

SEVERAL serious fires in the scaffolding of buildings and bridges during construction have resulted in large property loss and delay in completion.

The Bureau of Standards has received frequent inquiries relative to methods that can be employed to decrease this fire hazard, and some tests were undertaken employing several types of treatments meeting the special conditions involved. Impregnation or coating with many of the chemicals generally used to produce a fire retardant condition are objectionable on account of irritating effects on hands of workmen, particularly in case of injury. Also, no coating can be applied to the surface of the timber so opaque that it obscures defects that have a bearing on strength.

Various Chemicals Used

PRELIMINARY tests with various chemicals applied to the surface of the wood indicated that the penetration into the wood was insufficient to obtain any appreciable fire retardant effect. Of acceptable surface coatings, sodium silicate (water glass) appeared promising, and further ignition and spread of flame tests were conducted with this treatment.

The specimens for the ignition tests consisted of pieces of short-leaf or loblolly pine, Western pine, or Douglas fir, 10 inches square and ¾-inch thick, and for the spread of flame tests the specimens were 2 inches wide, 18 inches long, and ¾-inch thick. Except for a 3-inch length on one end of the long specimens, they were coated on all sides with one brush coat of sodium silicate of specific gravity 1.38, thinned with water to specific gravity 1.33.

The ignition tests were conducted by applying safety match flames, 1-inch yellow bunsen burner flames, and 8-inch blue bunsen burner flames for periods of one minute to the corner, edge, or flat side of the specimen. Burning continuing for one minute or more after removal of the igniting flame was considered as ignition. Ignitions using safety matches were obtained in 63 per cent of the trials with the untreated specimens and in 14 per cent of the trials with the treated specimens, the results being averaged for the three species of wood. Specimens exposed to the weather for about three weeks and subjected in this time to three rains, were ignited in 39 per cent of the trials. With the 1-inch bunsen flame ignition was obtained in 78 per cent of the trials with the untreated specimens and in 3 per cent when coated with sodium silicate. The 8-inch bunsen flame gave 97 per cent ignition with untreated specimens and 12 per cent when treated.

Testing Flames' Spread

IN THE spread of flame teats with the pieces held vertically the untreated 3-inch portion was ignited with a bunsen burner flame and the spread of flame on a 12-inch length of the treated portion noted. Taken as an average for the three species the flame spread over the 12-inch marked length of the untreated specimen was 8 inches, and only 0.7 inch for the treated pieces.

The effectiveness of the treatment was somewhat greater for the Western pine and Douglas fir than for the short-leaf or loblolly pine, possibly because of greater penetration. An additional coat would undoubtedly have increased the fire retardant effects considerably. The tests with the specimens exposed to the weather indicated loss of a considerable amount of the coating in three weeks' time, hence the treatment can be considered useful mainly for inside scaffolding.

It should be noted that the test conditions duplicate only those incident to the initial start and spread of the fire, and while a treatment that prevents ignition and retards the spread of fire from small sources is of value, it should not be understood as giving protection after the fire has attained any considerable volume. At the high temperatures incident to the latter condition surface coatings are readily destroyed or their effects otherwise nullified, and they can not retard appreciably the further spread of the fire.

(This article first appeared in the Technical News Bulletin of the Bureau of Standards.)

STONE PRESERVATION

ALTHOUGH preservative treatments for stone have been used for a considerable period of time, their value has often been questioned, according to a statement issued by the Bureau of Standards. The statement proceeds:

The type of preservative most frequently used in this country consists of a wax of stearate dissolved in a volatile solvent which is applied to the masonry with a spray or brush. This solution penetrates the pores of the masonry and, as the solvent evaporates the wax is left in the pores, forming a more or less effective seal. The preservative effect is supposed to be gained by preventing a penetration of moisture, thus overcoming the action of frost or other harmful effects which may result from dampness inside the masonry.

It has been proved that such treatments do not entirely seal the surface pores of stone, and for this reason there has been considerable doubt concerning their value, especially where the stone is subjected to abnormal amounts of dampness. The theory is sometimes advanced that, to seal or partially seal the surface pores when water can penetrate through or behind the treatment, will cause a condition under which the stone will decay from frost action at a more rapid rate than if the surface pores were left open. Since frost action on stone is the result of expansion of water in passing from the liquid to the solid state, this theory seems to be entirely sound for masonry exposed to very damp conditions where the material can become highly saturated; because the treatment would seem to hinder or prevent the extrusion of ice through the surface pores, and hence higher internal stresses would develop than if there were no surface seal.

In order to test this theory, some experiments recently have been made at this Bureau on parallel series of stone specimens, one of which was treated with a 10 per cent solution of paraffin in benzol, and the other left in the original state. Two sandstones and two limestones were selected for the experiments, all of which were known to have rather low resistance to frost action.

Soaked in Water

IN ORDER to test this theory, some of each kind with the preservative, the two series were soaked in water for 14 days and absorption tests made during this time after periods of 30 minutes, 24 hours and 14 days. While all of the treatments were indicated to be effective to the extent of greatly reducing the rate of absorption, at the end of the 14-day period the treated specimens had absorbed from 68 to 95 per cent as much as the untreated specimens. The two series were then placed in one-half inch of water in a tray and placed in the freezing chamber until frozen, after which they were taken out and thawed in water at room temperatures. This cycle was repeated until the specimens were all disintegrated.

AUSTRALIAN PROJECT

THE Wimmera-Mallee gravitation channel system in Australia is by far a most comprehensive plan for domestic and stock water supply service that probably will compare favorably with any similar scheme in the world, according to a report from Trade Commissioner S. R. Peabody, Melbourne. The Wimmera-Mallee section of Victoria is the major portion of the northwestern part of the state. The main supply of water for the scheme is drawn from five storage reservoirs in the catchment of the Wimmera River, at the foot of the Grampians and other ranges in the vicinity. The capacities of these main storages at present total 168,400 acre-feet, while subsidiary storages throughout the districts served by the scheme contain a further 14,650 acre-feet, making the total capacity of existing storages 183,050 acre-feet.

A most important factor in the great network of main and distributory channels is the provision, by the state rivers and water supply commission, for making the fullest use of the storages, by designing the channel system in such a way that the ordinary river flow can be used as a supplementary source of supply, so that the stored water may be reserved, as far as possible, for use in periods of low-river discharge. By this arrangement, the commission is able to divert direct from the river into its main channels in a normal year

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ZONING CITIES

(Continued from Page 6.)

desirable to deal with some isolated case by means of a retroactive provision affecting that case only. For this reason it does not seem wise to debar the local legislative body from dealing with such a situation.

No repeal clause has been included in the act for the reason that the method of phrasing such a clause will vary in nearly every State. The local legislative custom as to repeal clauses should be followed.

"Piecemeal Zoning"

AFTER the local legislative authorities have the power to zone they are nearly always pressed to bring immediate protection to certain threatened localities. Sometimes the authorities frame an ordinance to cover a few blocks, or only a part of the city; this is called piecemeal zoning. Its adoption is inadvisable and may lead to much litigation. Interim zoning, although undesirable, is not as objectionable as piecemeal zoning. Interim zoning, at least, has the advantage of applying to the whole city. For instance, an ordinance providing that wherever three-fourths of the houses in a block are residential, then no new business structure or factory can be built in that block, is an illustration of interim zoning. The reason it is objectionable is because it is too general, not sufficiently adapted to the particular need of each street, and, therefore, likely to be arbitrary in many cases. In such case, if a new house is built or an old one destroyed, the legal protection of the district may be altered. In this sense the district is a "traveling zone." As such, a district has no stability, and, as the police power may be differently applied according to the acts of property owners, it is not looked upon with favor by the courts. To prevent this the words "at the time of the passage of this ordinance" should be inserted. If it is deemed necessary to prohibit a nonconforming building because of the consents or protests of the property owners, the ordinance should always be phrased so as to prohibit the nonconforming use, unless the desired majority files written consents with the officials. In other words, a provision which conditions the permission to have a nonconforming use upon the consents of a majority of the property owners is void. If at all possible, the first zoning ordinance should be comprehensive.

STATE'S PLAN

THE State of Tennessee is to expend $37,700,000 on its highway program for 1930, according to estimates prepared in the offices of Commissioner R. H. Baker, of the department of highways and public works. Of this amount $20,000,000 will go into road building, including grading and drainage of projects; $4,800,000 will be devoted to the construction of toll bridges, and $3,500,000 for the construction of bridges of 20-foot spans and over.

This total also includes $7,400,000 to be expended in the maintenance of existing highways and $2,000,000 for administrative and engineering costs.

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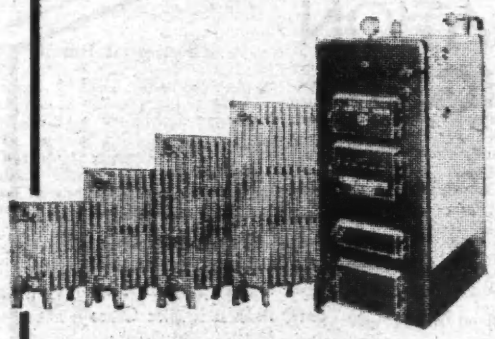

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COLONIAL BUILDING

(Continued from Page 3.)

in a fair measure for a period of fifty years without having a large settlement at Jamestown, nevertheless it had now been determined in earnest to establish one there. To accomplish this, each of the seventeen counties into which Virginia was divided at this time was ordered to build a house at Jamestown at its own expense. The authority was conferred on all to impress into service the mechanics needed for the work, such as bricklayers, carpenters, sawyers and other tradesmen. The strictest regulations were laid down to prevent every kind of exaction. The bricks were to be manufactured in the most careful manner and were in size to represent statute measure; the price was not to exceed one hundred and fifty pounds of tobacco ($2.10) for every thousand. In addition to receiving his food without charge the ordinary laborer engaged in erecting a house was to be paid at the rate of two thousand pounds of tobacco ($28) a year. The brickmakers and bricklayers were to be remunerated according to the number of bricks moulded and laid, while the wages of each carpenter were not to exceed thirty pounds of tobacco (42 cents) a day. Each sawyer was to receive half a pound of tobacco for every foot of plank and timber for joices which he fashioned into shape. The keepers of the taverns at Jamestown were required to supply the ordinary laborer with food at the rate of one thousand pounds of tobacco ($14) a year, and the most skilled workmen at the rate of fifteen hundred ($21). An important provision of the law was that after its passage no wooden house was to be erected in Jamestown, and all such houses then standing should not be repaired with the same material, but should be replaced by structures of brick.

"This brief synopsis of the law of 1662 shows how elaborate were the provisions of that measure for the enlargement more especially of Jamestown. As far as legislation, independently of favorable local conditions, could create a town where none existed, it might be supposed that the law would have been successful in accomplishing its object, so far, at least, as the capital was concerned. It provided in detail for the erection of a number of houses at a cost which was distributed among the people of the seventeen counties. The mechanics to be employed in the work were to be provided for properly, and to be fully remunerated for their labor."

Contemporary Evidence

TO ANSWER the question of "what was the practical result of all these carefully considered provisions?" Bruce draws upon contemporary evidence and finds that "three years after their adoption Secretary Ludwell, writing to Secretary Bennett in England, stated that enough of the proposed town had been built to accommodate the officers employed in the civil administration of Virginia, but this, it may be inferred, * * * amounted only to the construction of four or five houses. He declared that the erection of this scanty number of buildings had entailed the loss of hundreds of people, apprehension of impressment having driven many mechanics from the colony." [24]

The wages provided for in the cohabitation act seem to be higher than the prevailing rate, for later, in 1666, the Colonial Court ordered that in the reconstruction of the fort on Point Comfort workmen should receive 20 pounds of tobacco for a day's work, an order which applied equally to skilled mechanics and common laborers.[25] Tobacco is valued at this time at 1d. a pound," which makes a day's pay in tobacco about equivalent to 1s. 8d. (28 cents) in currency.

Close of Century

A FEW scattered records complete the available data for the seventeenth century. Under date of Sept. 26,163, Hendrick Van Borsum of New Amsterdam contracted "to serve the Honorable Governor as Carpenter for the period of the current year commencing to-morrow; for which service he shall receive a salary of fl. 30 a month (equal to $12.—Ed.) without board. * * * but whenever he shall be sent to work without the city he shall be provided with victuals." [26] Salem, Mass., built a town hall in 1677 and paid the carpenter £20 ($66.67), "one-third in money and two-thirds in provisions" for his work."

A BUILDING contract entered into in Henrico County, Va., in 1679, called for the erection of a house 40 feet long and 20 feet wide, clapboarded and roofed, with a chimney at either end, "the upper and lower floors to be divided respectively into two rooms, by a wooden partition." The house was to be finished in seven months, and the owner agreed to pay the builder "twelve hundred pounds of tobacco in cask." Tobacco was probably worth about 2d. a pound, and 1,200 pounds converted into American money would amount to $33.60. A few years later a carpenter in a neighboring county agreed to build a house of similar dimensions for £9 sterling, or $43.74."

The usual rate of pay for building craftsmen in New Jersey in 1680-1685 was 2s. (40 cents) a day; in Amboy, "where building was active," mechanics received 2s. 6d. (50 cents)[27] a day. "The houses building at Amboy in 1683 are described as usually 30 feet long, 16 feet wide, 10 feet between points, with double chimney of timber and clay 'as the manner of this country is to build,' and cost about £50 ($200) each." [28]

Thomas recorded that in Pennsylvania in 1698 "Carpenters, both House and Ship, Bricklayers, Masons, either of these Trades-Men will get between Five and Six Shillings ($1 and $1.20)[29] every day constantly. Brickmakers have twenty shillings ($4) a thousand for their Bricks at the Kiln," and "Plasterers have commonly eighteen pence (30 cents) a yard for Plastering."

[24] Idem, Vol. II, pp. 540-545. [25] General Court Orders, Mar. 29, 1666—Robinson transcript, pp. 112-113. [26] Jacobstein—See p. 13. [27] New York Colonial Documents, Vol. II, p. 617. [28] Felt's Annals of Salem, Vol. I, p. 390. [29] Bruce, Vol. II, pp. 151-152. [30] Colonial shilling of Pennsylvania and New Jersey, worth 20 cents. [31] Bishop, p. 109, footnote.

Code Covering Building Exits

THE 1929 edition of the Building Exits Code has been approved as an American tentative standard by the American Standards Association, and published by the National Fire Protection Association, the sponsor for this project. The code is a revision of the 1927 edition, embodying a new section on places of public assembly and additions to the section on schools.

Safe exit provisions are made for schools, hospitals, department stores, factories and places of public assembly. The provisions of the code cover stairways, fire escapes, elevator and escalator platforms, doorways and practically every other factor of construction entering into the safe exit from buildings in case of fire. In classifying the different types of buildings, distinction is made between low-hazard, moderate-hazard and high-hazard buildings. Hospitals, schools and office buildings are included in the low-hazard section; department stores and such industrial plants as bakeries, boots and shoes and woolen clothing are considered to present a moderate hazard; dry-cleaning establishments, cotton-clothing plants and most chemical plants are classified as high-hazard buildings.

Considerable attention is also devoted to fire drills. "Fire is always unexpected," says the code. "Drills should be so arranged that they will insure orderly exit under the unusual conditions obtaining in case of fire. For this reason drills should be habitually held in unexpected ways, and at the same time it loses much of its value, and when for some reason in actual fire it is not possible to follow the usual routine of the fire exit drill to which occupants have become accustomed confusion and panic may ensue.

"Drills should be carefully planned to simulate actual fire conditions. Not only should they be held at varying times, but should use different means of exit, assumption being made, for example, that some given stairway is unavailable by reason of fire or smoke, all the occupants being led out by some other route. Fire exit drills should be designed to familiarize the occupants with all available means of exits, particularly outside stairs and other emergency exits that are not habitually used during the normal occupancy of the building."

GYPSUM COMES INTO ITS OWN

Material Known to the Ancients Plays Major Role in Modern Building

By R. M. SANTMYERS
Mineral Specialist, U. S. Bureau of Mines

DURING recent years the construction industry has been forced to meet many intricate problems forced upon it by demands for the utmost in facilities and conveniences. Many of these problems have been solved by development of new and extended uses for old and familiar materials.

Gypsum, a nonmetallic mineral, is one of the long-known materials to which the construction industry has applied new uses in the production of modern structures.

The date of the discovery of the use of gypsum is unrecorded, but its value as a building material has long been known. Plaster was made from calcined gypsum by the Egyptians, and the ancient Assyrians used alabaster, the white crystalline form of gypsum, for sculpture and other works of art. The soft luster given to the light as it passed through transparent plates of gypsum reminded the ancients of the light from the moon, and so they named this variety of gypsum selenite, from the Greek word meaning moon. Selenite was regarded by these people as the most delicate variety of alabaster, and was used by the wealthy as windows in their palaces.

Walls of Old Temple

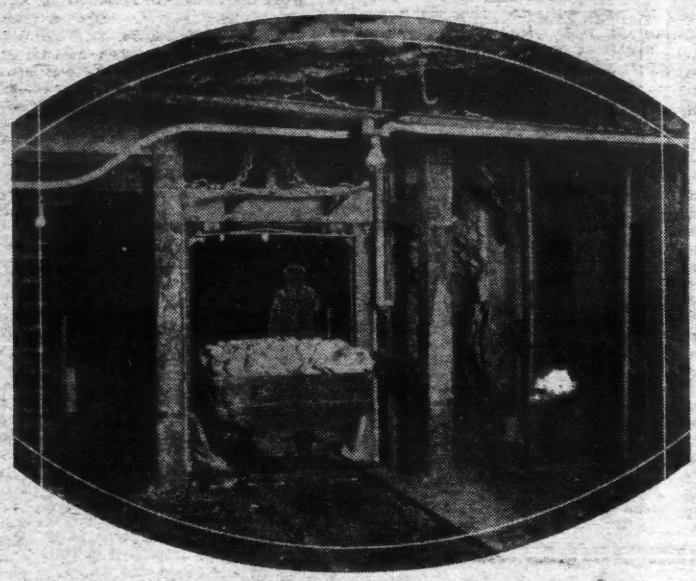
THE walls of the old temple of Fortuna Seia were constructed of stone supposed to be compact gypsum, and the interior, though without windows, was rendered sufficiently light by rays transmitted through its semipellucid walls.

At Florence the gypsum of Volterra was made into vases in which lamps were placed, throwing a soft light over the room. In Arabia the building of Arsoffa Emii, supposed to be an old monastery, is constructed of gypsum; it exhibits considerable decay though of no great age.

The writings of Theophrastus and Pliny show that the Greeks were familiar with the uses of plaster in making casts. According to the former, the first plaster casts were made by Lysistratus of Sicyon, who was a brother of the famous sculptor Lysippus. He made first a cast in plaster from the object and from this obtained a second one in wax. Rhaecas and Theodorus of Samos worked by the same method, but the art appears to have attracted very little attention and was soon neglected and in course of time forgotten. It was revived by Verocchio (1422-1488) and others, when the method of casting in plaster proved of great service in obtaining copies of the specimens of ancient sculpture which were then discovered.

The great pyramids of Egypt contain gypsum plaster work which was executed at least 4,000 years ago and today is still hard and durable.

The use of gypsum in the United States dates back about a century and a quarter. The early settlers in their westward movement were the first to use gypsum, practically all in the form of land plaster or fertilizer.



Typical view in a gypsum mine showing the method of obtaining the raw material, which plays a major part in modern construction operations.

Gypsum was discovered in New York as early as 1792, but it was not until exactly a century later, 1892, that the first production of plaster of paris from gypsum mined in the State was reported. In 1882, however, considerable quantities of rock gypsum from Nova Scotia were said to have been used in the manufacture of plaster of paris in New York. The first use of gypsum in Virginia was in 1835 as land plaster, and about 1840 the deposits near Grand Rapids, Mich., were discovered. It was next utilized in Ohio, near Sandusky, in 1850; in Iowa, in the vicinity of Fort Dodge, in 1872; and in California in 1875. The first mill for the manufacture of gypsum into plaster of paris was built by George Morrison, at Morrison, Colo., prior to 1875.

In 1875 a plant was erected at Colorado City, Colo., at a cost of $16,000, a plant with a capacity of 15,000 pounds of plaster daily, which was about three times the demand in the State. Practically no plaster was made, however, until 1879, in which year about 300,000 pounds were produced.

Since 1880 the growth of the gypsum industry has been very rapid. During the period 1898 to 1903 the increase in production was more than 350 per cent; it was then that gypsum wall plaster began to be used extensively. Largely as a result of its growing use as a building material the industry has grown in annual output from $750,000 in 1898 to approximately $47,000,000 in 1926 ($32,000,000 in 1928).

Gypsum, either as finely crushed rock or gypsite (earthy gypsum), when heated to about 230 to 260 degrees F., boils violently and evolves much of its water of crystallization as steam. The material is then "plaster of paris," which, upon the addition of water, sets rapidly and forms a hard, rocklike substance. This plaster of paris is used sometimes alone, but more often mixed with inert substances, in the manufacture of wall plaster, blocks and tile, wallboard and plaster board, lath, wall finishes, etc.

Addition of Materials

ALL gypsum wall plasters have other materials added to the calcined gypsum either before sacking or just before wetting for use. These plasters, commonly known as hard wall plasters (of which there are many brands), may be grouped into four classes, namely: (1) Cement plaster—calcined gypsum, retarder, and with or without hair; (2) wood-fiber plaster—calcined gypsum, retarder, and wood fiber; (3) prepared plaster—calcined gypsum, retarder, sand, and hair or wood fiber; and (4) finishing plaster—calcined gypsum, with or without retarder, and with or without hydrated lime.

Plaster board, a relatively new product, has contributed largely to the rapidly growing use of gypsum in the building construction industry in recent years. It may be divided into three classes, namely: (1) Wall board, to be used without plaster; (2) plaster board, upon which plaster is to be applied; and (3) gypsum lath, a plaster board of smaller dimensions which is used to replace wood or metal lath.

Another group of gypsum products which has forged rapidly into popular favor comprises gypsum blocks and tile. These are used for partitions, both load-bearing and nonload-bearing, floors, roofs, and furring.

Keene's cement, one of the oldest products manufactured from calcined gypsum, has followed the general upward trend of the other gypsum building materials. It consists of dead-burned gypsum, generally heated to 900 to 1,100 degrees F., to which the property of quick-setting is restored by the use of certain salts.

The most important use for calcined gypsum, amounting to about 2,500,000 to 3,000,000 tons annually, is as wall plaster, often called stucco. The whiter varieties are called, in connection with certain trades, plaster of Paris. Wall plaster, commonly known as hard wall plaster, may be grouped into four classes: (1) Cement plaster—which contains calcined gypsum and retarder, with or without hair; (2) wood-fibre plaster, which contains calcined gypsum, retarder and wood fibre; (3) prepared plaster, which contains calcined gypsum, retarder, sand, and hair or wood fiber; and (4) finishing plaster, which contains calcined gypsum, with or without retarder, and with or without hydrated lime.

Types of Plaster

NEAT gypsum plaster (more commonly but wrongly called "cement plaster") ordinarily contains no less than 85 per cent of calcined gypsum, the remainder being hydrated lime, ground clay, asbestos, retarder, or fiber. Four to 6 pounds of goat or cattle hair are used in each ton of plaster. In addition, some manufacturers use 1 or 2 pounds of manila or sisal fiber. The purpose of the fiber is to hold the plaster together while it is being applied and to prevent it from dripping from the keys that are formed behind the lath.

Wood-fiber plaster contains at least 80 per cent by weight of calcined gypsum and not less than 1 per cent of a nonstaining wood. The remainder may be composed of hydrated lime,

(Continued on Page 11.)

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HEAT INSULATION

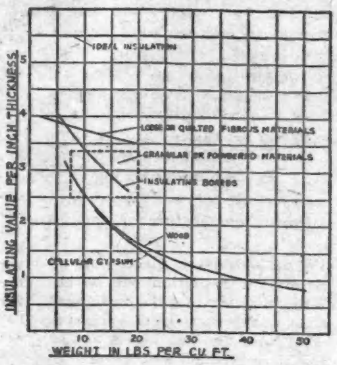
(Continued from Page 4.)

a general picture which is accurate enough for most purposes. One class of materials used to some extent for insulation—namely, loose powdered or granular materials, such as granulated cork, sawdust, charcoal, etc.—can not be represented by a single line in the chart. The insulating values of materials of this class fall within the area inclosed by the dotted lines shown in the figure.

Insulation of Buildings

FROM the point of view of insulation only, the most important question is the thickness of insulating material to be applied, rather than what material to select, provided the choice is restricted to the class of cellular or fibrous materials. No known material in a very thin layer can be expected to provide an appreciable amount of insulation. On the other hand, a relatively thick layer may not be economical, since relatively little additional gain is made over some layer of intermediate thickness. The selection of a material for a particular purpose must be governed largely by the requirements of that purpose in the way of structural strength, cost, fire hazard, etc. The real cost of an insulating material is obviously not the cost per square foot of commercial thickness but rather the cost per unit insulating value of the commercial thickness.

If a layer of insulating material is added to a wall, the insulating value of the wall will be increased by an amount equal to the insulating value of the layer of material added. The thicker the layer the greater will be the insulating value of the resulting wall. The percentage increase



in the insulating value of the wall, however, will depend upon the original insulating value of the wall without insulation. The percentage increase in the insulating value of an actual wall containing windows will also obviously depend upon the amount of glass surface and the air leakage around windows and doors, since these factors are unaffected by the addition of insulating material.

A great many types of walls and roofs are to be found in present-day dwelling-house construction. The insulating value of one type or individual may be considerably different from that of another, but in an actual building heat losses through and around windows and doors tend to level out the effect of these differences in the properties of the walls themselves to such an extent that there are no wide variations in the amounts of fuel required to heat houses of various types of the same size in the same locality, unless air leakage around windows and doors or through very poorly constructed walls is excessive.

TABLE 1.—APPROXIMATE FUEL SAVINGS IN DWELLING HOUSES

(Expressed in percentage of fuel which would have been required for similar house without insulation or weather stripping)

	Saving Per cent
No insulation, weather stripped	15 to 20
Same, with double (storm) windows	25 to 30
½-inch insulation, not weather stripped	20 to 30
½-inch insulation, weather stripped	About 40
½-inch insulation, with double windows	About 50
1-inch insulation, not weather stripped	30 to 40
1-inch insulation, weather stripped	About 50
1-inch insulation, with double windows	About 60

(Expressed in percentage of fuel which would have been required for similar house without insulation, but with weather stripping

	Per cent
With double windows, no insulation	10 to 15
½-inch insulation only	25 to 35
½-inch insulation, with double windows	40 to 45
1-inch insulation only	35 to 45
1-inch insulation with double windows	50 to 55

Methods Not Outlined

NO PARTICULAR description of insulation methods will be made here, since all manufacturers furnish specifications describing the proper methods of applying their materials. With regard to roof insulation, however, it may be remarked that if the building has an attic or air space, insulation is best applied either on or in between the ceiling joists of the top story. This, of course, assumes that there is no necessity for keeping the attic warm in winter. If there is a necessity for doing this, the insulation must be applied to the roof itself.

An estimate of the probable savings in fuel resulting from insulating or weather stripping an ordinary dwelling house is given in Table 1. The first part of the table gives the fuel saving expressed in per cent of fuel which would have been required for a similar house without insulation or weather stripping. In the second part of the table the savings are expressed in per cent of fuel required for a house without insulation but with weather-stripped windows. The calculations were based on data on heat transfer in building construction taken from the "Guide," published by the American Society of Heating and Ventilating Engineers. An average insulating material ($K = 0.31$) is assumed, but no commercial fibrous or cellular insulating material departs far enough from this average value to make a significant difference in the approximate figures in Table 1. In taking into account the effect of windows and doors, it is assumed that the aggregate area of such openings is equal to one-fifth of the total side wall surface, and that the heat loss through such openings is that corresponding to a 5-mile wind striking perpendicular to the wall. This corresponds roughly to average conditions over a large part of the country. Whenever insulation is involved it is assumed that the insulation is applied to both walls and roof, and that the insulation is not substituted for some other member which is present in the uninsulated construction.

The ranges in values correspond to the extremes in wall constructions usually encountered in average dwelling houses. As a general rule, ordinary walls of solid masonry are somewhat less effective in retarding heat loss than well-constructed frame or hollow-tile walls. A somewhat greater percentage saving in fuel is, therefore, obtained by insulating a solid masonry wall than by applying the same insulation to a frame or hollow-tile construction. Any house representing a considerable initial investment, particularly one with solid masonry walls, should be insulated, since the cost of insulation is a small proportion of the total, and the resulting additional comfort and fuel saving is considerable.

Factors Are Variable

IT SHOULD be borne in mind that any calculations dependant on experimental values of air leakage around windows are subject to great uncertainty on account of the variability of the factors involved. A well-built house without weather stripping may when new show less heat loss by air leakage than has been assumed in calculating the fuel savings given in Table 1. The gain resulting from weather stripping such a house would be correspondingly less. It should also be realized that infiltration of air is not necessarily disadvantageous, since a certain amount of ventilation is necessary. In the ordinary dwelling house air leakage is relied upon to furnish part of the ventilation, and it is unwise to attempt to prevent such leakage altogether. It does not appear, however, that ordinary weather stripping will reduce the air leakage to an excessively low value.

The calculations involving insulation are much more definite and certain than those involving air leakage. The application of insulation results in a certain absolute saving which is independent of heat loss through or around windows and doors. The per cent saving of fuel, however, is still dependent upon the heat loss through the uninsulated openings.

If a layer of material is placed in the middle of a wide air space, such as that between the studs in a frame wall, greater additional insulating value is obtained than if the material is placed in contact with the sheathing, or as a plaster base, as has been assumed in the calculation for Table 1. In the former case the insulating layer not only furnishes its own insulating value, but, in addition, divides the air space into two parts, each of which has about the same insulating value as the original air space. The addition of a ½-inch layer of insulation in the middle of the air space in a frame wall is, therefore, the equivalent of adding a little more than three-fourths inch at some other place in the wall. The process of subdivision of an air space, however, can not be carried too far, since the resultant spaces become narrow and are not so effective as insulators. The air space formed by the use of furring strips under plaster or stucco is nearly as effective as a wider air space, but narrower air spaces than this are less effective.

Aside from the saving in average fuel consumption and possible increase in comfort, the insulation of a house may allow a smaller initial investment for heating plant. In the extreme case of a structural wall of

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ON GYPSUM

(Continued from Page 9.)

ground clay, asbestos, sand or substance of similar nature, and retarder. Thirty to 40 pounds of shredded poplar, lime, willow or buckeye wood are used to a ton of plaster.

Wood-fiber plasters are intended for use where sand is scarce or expensive, or where unusual toughness and a measure of flexibility is desired. They are intended to be used without admixture of sand, and are especially convenient for patchwork. Most sand has an accelerating influence on gypsum plasters, since they are prepared for use without sand; less retarder may be used than for those kinds intended for use with sand. Ordinarily 4 or 5 pounds of commercial retarder to the ton will keep such plaster in proper working condition for two hours, which gives ample time for mixing and applying.

Considerable quantities of ready-mixed gypsum plasters are shipped from some mills. In some of the larger cities mixing plants take the calcined gypsum in car lots and mixed it with sand for the local trade. It is not economical to ship sanded plasters any considerable distance. If local sands are not suitable for mixing, it is generally cheaper to use wood-fiber plasters.

Keene's cement consists of dead-burned gypsum, that is, gypsum heated to 500 to 600° C. (900 to 1,100° F.), to which the property of quick-setting it restored by the use of certain salts which act as positive catalyzers. It is made by calcining lump gypsum to a red heat; treating with a 10 per cent solution of alum; reburning to a dull red heat and then grinding.

Accelerating Substances

SUBSTANCES that will serve as nuclei about which crystallization may start will speed the set of gypsum plasters. Certain other substances also hasten crystallization directly.

Raw gypsum is a powerful accelerator, but it is not recommended for this purpose, for its effect in other ways is generally regarded as unsatisfactory. Calcined gypsum, which has been set up and after drying has been ground, is the form of accelerator usually furnished by gypsum producers. Eight or 10 ounces of this material to the 100-pound sack of plaster will speed the set about an hour. This accelerator should be dry mixed through the plaster and sand.

Three ounces of zinc sulphate dissolved in water will likewise speed the set of a 100-pound bag of ordinary plaster about an hour. It should be mixed in the water used in gauging the plaster. Alum may be used as an accelerator in the same manner, although slightly more alum will be required per bag of plaster to produce the same degree of acceleration. A few pounds of portland cement or hydrated lime bay be added to each bag of plaster as an emergency accelerator, though it is not recommended.

A great many substances have been used to retard the set of calcined gypsum and of gypspm plasters. Any material that will temporarily interfere with the growth and interlocking of the gypsum crystals as they form from solution, or will take up temporarily part of the water and later release it, will lengthen the setting time of calcined gypsum.

Clays and colloidal clays in particular act as effective retarders. Gypsite plasters, which contain 10 to 20 per cent of clay, require little in the way of additional retarder. The ancients used dried blood, and small quantities of sugars and syrups may be used in an emergency. Pulverized glue is an effective retarder. Two pounds of glue may be dissolved in 40 gallons of water and used in proportions so that three ounces of glue are added to 100 of plaster, if an hour of additional setting time is desired. As an emergency retarder citric acid may be similarly used.

The amount of standard retarder used in different kinds of gypsum plasters may vary from 1 to 15 pounds per ton of plaster. Gypsite plasters, as previously noted, require very little retarder other than the clay naturally present. Wood fiber plasters for use without sand require only three or four pounds of retarder, while plasters intended to be mixed with three parts of sharp sand for use on brick or terra cotta may require eight or ten pounds of retarder.

Plasters intended for mixing by machine are retarded heavier than other plasters, for it is difficult to keep the mixer clean, and additional retarder is needed to overcome the accelerating effect of set plaster.

low insulating value the addition of insulation may also prevent possible condensation of moisture on the inside surfaces of the external walls. Such condensation is due to the fact that the temperature of the inside surface of a poor wall may fall below the dew point of the air in the room. Decreasing the heat transfer through the wall by the addition of insulation will increase the temperature of the inside surfaces, and thus tend to prevent condensation.

In summer the effect of insulation is beneficial, but too much should not be expected in this respect. Increasing the total insulating value of a wall or roof will always tend to keep the building cooler during the hot part of the day, but many other factors in addition to the insulating value enter into the question in a rather complicated way. In general, thick masonry walls having large heat-storing capacities are better relatively than insulated walls. The insulation of roofs is probably much more effective than the insulation of walls, since the former have much greater exposure to the sun.

A great deal of misconception is prevalent regarding the use of paints as insulators. Since a paint film is relatively thin, it can offer but slight resistance to heat flow by conduction. The color of the external paint, however, has a considerable effect on the absorption of heat from the sun. Light-colored paints are more desirable, since they do not absorb as much solar heat as dark-colored paints. The reradiation of heat from the underside of a hot roof also can be reduced by coating the underside with paint containing metallic flakes in its composition, such as aluminum paint. The beneficial effects of proper painting are considerable if the roof has practically no insulating value in itself (for example, a tent), but if the roof itself has considerable insulating value the effects of painting are small.

Cold-Storage Insulation

THERE is no essential difference between insulating against heat and insulating against "cold." A refrigerator is an inclosure maintained at a relatively low temperature, and it is desirable to reduce heat transfer from the outside to the inside. The same principles apply as in the case of house insulation, but the magnitudes are generally different. As a general rule, a refrigerator should be much better insulated than a house, both to save refrigeration (ice or electricity, etc.), as well as to produce a lower temperature on the inside.

While no extensive discussion of this variety of insulation will be entered into here, it may be remarked that an ordinary household refrigerator should have the equivalent of not less than 2 inches of insulation. If ice is used as the refrigerant, such a refrigerator, when operated properly, will maintain a low enough temperature for ordinary household purposes.

The question of the so-called "moisture-resisting qualities" of insulating materials merits some mention at this point, since it is an important one in refrigerator or other cold-storage insulation. Ordinarily it is of minor importance in house insulation. No tests have been made at the Bureau to compare materials on the basis of their moisture-resisting qualities, since tests of this kind should be made on completed constructions rather than simply on the materials themselves.

To the best of our knowledge, no commercial insulating material is in any sense waterproof or moisture proof. If immersed in water or kept in air at 100 per cent humidity, one material may absorb water less rapidly than another, but this fact is of minor importance. All the materials in question are permeable to water vapor, and if the insulation is colder than the outside air and is not protected on the outside most of the water vapor which diffuses into the insulation from the outside will condense and accumulate, eventually producing a more or less saturated state and lowering the insulating value many times. In a completely saturated state there is undoubtedly very little difference between the respective thermal conductivities of various commercial materials. The only remedy for this state of affairs is adequate protection on the outside by means of air-tight coatings, and, when possible, vents from the insulation to the inside should be provided. The latter allow the insulation to dry out, since the inside air is colder. As a general rule applying to insulated structures, air-proof the warm side and ventilate the cold side to the colder air. In no case should the insulating materials themselves be relied upon to prevent water accumulation.

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BIDDING METHODS IN GENEVA

ADVOCATES of the system of prequalification of bidders for public construction work may find interest in recent announcements of the methods under which proposals to build structures for the League of Nations at Geneva are to be considered. Information on this subject has been made public by the Bureau of Foreign and Domestic Commerce of the Department of Commerce in the form of a report from Consul G. G. Blake Jr. at Geneva.

The statement issued by the secretary general of the League of Nations outlining the procedure covering bidding on the proposed structures follows in full text:

The building committee of the League of Nations, with a view to the allotment of contracts for the construction of the new buildings, desires to make known the procedure to be followed by firms who may wish to tender for any work in connection therewith. The buildings comprise: (a) the great assembly hall, (b) the secretariat building, and (c) the library.

In view of the impossibility of publishing separate advertisements of each tender in the press of all member states on account of the delays which would result, it has been decided to establish forthwith a list of approved firms in all trades.

Applications for registration will be made on the basis of the conditions set out below.

Firms in all trades who wish to tender should forward to the secretariat of the League of Nations (Geneva, Switzerland), as soon as possible, their names and references, indicating exactly the work for which they desire to compete.

Firms should appoint in good time an accredited representative in Europe to deal with documents relating to the contract conditions.

The building committee of the League of Nations reserves the right to exclude any firm from the approved list without obligation to indicate the reason for such exclusion. Documents sent to the secretariat will be returned to those firms not admitted to tender.

Approved firms will be invited to tender for work in each trade or group of trades as and when the work is put up for tender. Notifications will be sent to the head offices of firms in Europe and to the European representatives of firms outside Europe.

All tenders must be accompanied by a deposit, as a guarantee of maintenance of the conditions offered. This deposit will be returned to unsuccessful competitors, but it will be forfeited to the League of Nations if the firm to whom the contract is allotted declines it for any reason. The amount of this deposit will be specified in the special conditions for each contract, and may vary from 1 to 2 per cent of the estimated amount of the contract.

The list of approved firms in each trade will be closed two months before tenders are invited in that trade. The firms concerned may inform themselves of this date either directly or through their representatives.

Fifteen days after the invitation to tender, competitors may consult at the architects' office in Geneva the contract conditions, plans and other drawings relating to the contract in question.

All these documents will be held at the architects' office at the disposal of competitors for a period corresponding to the importance of the contract. This period will be indicated in the invitation to tender.

A copy of the contract conditions and of the principal plans will be furnished on demand to competitors or their accredited representatives on payment of the costs of printing and reproduction, according to the scale of charges fixed by the building committee.

Competitors must present their tenders by a date which will be fixed in the invitation to tender in each case.

The building committee of the League of Nations will not consider itself bound to accept the lowest tender.

Recently the question of allowing tenders from firms of nonmember states for the construction, furnishing and equipment of the League's new buildings has been thoroughly discussed by the appropriate League authorities, and it is said that, as the matter now stands, such firms will be allowed to offer tenders.

Farm-to-market Road Plans

By ROY COCHRAN

State Engineer, State of Nebraska

THE average cost of gravel surfacing in Nebraska, taking the State as a whole and figuring both the use of local gravel as well as that of shipped-in gravel, is about $2,500 per mile. The average cost of 20-foot width slab of pavement, such as built during the year 1929, is approximately $20,000 per mile, with a low price of $18,180 for the year 1929.

It is also interesting to note that some of the outstanding improvements made during the year 1929, such as pavement between Union and Omaha.

It is felt that the State highway system as a whole was laid out generally in such a way as to be of the most advantage for farm-to-market traffic, and the surfacing of this system of highways, together with the feeders which will be built by the counties, will within a very few years constitute a complete network of farm-to-market roads as well as provide a means for intercounty as well as interstate traffic.

Home Building And the Nation

(Continued from Page 1.)

ship that customers should be and should remain satisfied with their purchases. The idea of selling a man a house that he cannot pay for has been justly condemned as bad business by the great bulk of leading real estate firms. Sound principles of merchandising are the order of the day.

It has been suggested that the American people are not sufficiently well aware of the value of a home as an investment.

I do not mean necessarily that it is worth so much for a man to own his home that he need not be concerned with whether or not he is getting his money's worth. There is a real need in most communities for agencies from which disinterested advice can be obtained.

But a home as an investment differs in type from a stock or a bond. It gives a man bigger stake in his community and its government, and thus helps to make a citizen of him. It makes him more independent.

For example, if he wants to repaper the house, it is his own responsibility whether or not he does it, rather than his skill in dealing with a rental agent. It certainly contributes to solidarity in family life, and permeates, for the good, the whole outlook of a family on the world about them.

There will be encountered the immediate problem of aiding in the rapid restoration of financing facilities up to the point where they were before the drain from the security markets was generally felt. I hope that the impetus attained when that point had been reached will carry forward into a distinct improvement in the second mortgage situation, the complete solution of which may require years of effort, supplemented by research and changes in laws.

The administration is thoroughly committed to the advancement of the American home. We have a division of building and housing devoted to promoting the interest of home owners, and I hope that its facilities may be of some value at this time.

The work of Better Homes in America, of which Secretary Wilbur is now president, has our general support. We recognize that the providing of houses is one of the most complex and difficult functions of American business, nationally and locally.

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